

What is claimed:

1. A method of controlling the movement of plural trains along a network of track, comprising:

(a) dividing the network into plural planning areas, with each pair of adjacent planning areas sharing at least one common boundary element on track common to said adjacent pair of planning areas;

(b) developing a local movement plan for each planning area independently of the movement plan for other planning areas to control the movement of trains into and out of the selected boundary elements associated with the planning area;

(c) evaluating the local movement plans for adjacent planning areas to identify conflicts at the respective boundary element; and

(d) modifying the local movement plans for adjacent planning areas to resolve the identified conflicts.

2. The method of Claim 1 further comprising:

(e) monitoring the actual movement of the plural trains over the network of track;

(f) periodically updating the local movement plans as a function of the actual movement of the trains.

3. The method of Claim 1 wherein said developing a local movement plan for each planning area is performed asynchronously with the development of the movement plans for other planning areas.

4. The method of Claim 1 wherein said dividing the network into planning areas includes dividing the network as a function of the amount of proposed traffic for the track of each planning area.

5.. The method of Claim 1, wherein the network of track comprises plural configurations of track and the step of dividing comprises selecting boundary elements as a function of the configuration of the track common to adjacent planning agents.

6. The method of Claim 1 wherein the planning time horizon of each local movement plan is approximately eight hours.

7. The method of Claim 6 wherein each local movement plan is updated approximately hourly

8. A method of scheduling the movement of plural trains along a network of track, comprising:

(a) dividing up the network into a plurality of planning areas separated by boundary elements, with each boundary elements comprising a portion of the network of track which is common to respective planning areas;

(b) generating a movement plan for each planning area independently of other planning areas to control the movement of trains into and out of the boundary elements;

(c) evaluating each of the movement plan and identifying scheduling conflicts at respective boundary elements; and

(d) modifying the movement plans for the planning areas to resolve the identified conflicts.

9. The method of Claim 8 wherein said evaluating each of the movement plans includes:

- (e) assigning a business objective function for each of the trains in the planning area;
- (f) evaluating the business objective functions for each of the trains; and
- (g) identifying a capacity of the boundary element, constraints on occupancy times and the planned usage of the specified boundary element from each of the planning areas.

10. The method of Claim 9 wherein said modifying the movement plan includes:

- (h) providing movement order constraints for the each boundary element; and
- (i) proving an order for the trains to move through the boundary element.

11. The method of Claim 8 wherein said generating a movement plan for each planning area is performed asynchronously with the generation of the movement plan for other planning areas.

12. A method of providing a detailed train movement plan for controlling the travel of plural trains of plural components along an interconnected network of tracks across a global planning area comprising:

- (a) dividing the global planning area into plural local planning areas each including a portion of the network of tracks, the boundaries of adjacent local planning areas being crossed at points of network transition having common track elements (boundary elements);

(b) providing a daily schedule for all trains transiting the network, the daily schedule providing waypoints and activity locations and time of arrival and departure at, each of the waypoint and activity locations;

(c) providing a local movement plan (“LMP”) for each of the plural local movement areas revising the times of arrival and departure at the waypoints and activity locations to attempt to resolve all of the conflicts as to the usage of the portion of the network and train components within a local area independently of the resolution of any such conflicts in any other local area;

(d) comparing the LMPs having common boundary elements and resolving any conflicts in the common boundary elements by revising the LMPs.

13. The method of Claim 12 further including:

(i) independently monitoring the actual movement of train components over the network within each of the local planning areas; and

(ii) periodically updating each of the LMPs as a function of the monitored movement of train components.

14. The method of Claim 13 further comprising:

(i) comparing the updated LMP from each of the local areas with common boundary elements:

(1) periodically; and/or

(2) each time the LMP is updated.

15. The method of Claim 12 wherein said dividing comprises dividing the global planning area into plural local planning areas as a function of the amount of track included within the local area and the amount of proposed traffic for such included track.

16. The method of Claim 12 wherein said comparing the LMPs includes the step of identifying a conflict which can not be resolved.

17. A method of scheduling the movement of plural trains along a network of track, wherein the network is divided into a plurality of planning areas, comprising:

(a) selecting the size of each planning area as a function of the amount of track and amount of proposed train traffic along the track in the planning area;

(b) selecting the boundaries as a function of the portions of the network of track which is common to adjacent planning areas

(c) developing a movement plan for each planning area.

18. The method of Claim 17 wherein said developing a movement plan is performed independently for each planning area.

19. In a method of scheduling the movement of trains along a network of track, wherein the network is divided into plural planning areas and a local movement plan is generated for each planning area, the improvement wherein each local movement plan is generated independently from the other movement plans.

20. The method of Claim 19 wherein each local movement plan is generated asynchronously from the other movement plans.

21. In a method of scheduling the movement of plural trains along a network of track, wherein the network comprises a plurality of track configurations and is divided into a plurality of planning areas, the improvement where the boundaries of the planning areas are selected as a function of the configuration of the track that is common to adjacent planning areas.

22. A method of controlling a plurality of trains over a network of track using a computer program to develop a movement plan for the plurality of trains, and a human dispatcher to implement the movement plan, comprising:

- (a) dividing the dividing the network into plural planning areas as a function of amount of track; each planning area separated by boundary elements comprising portions of the network track which is common to adjacent planning areas;
- (b) developing a local movement plan for each planning area;
- (c) dividing each planning area into a plurality of dispatch areas;
- (d) providing a portion of the local movement plan corresponding to each dispatch area to a human dispatcher to implement the portion of the local movement plan.

23. The method of Claim 22 wherein said developing a local movement plan is performed independently for each movement plan.

24. The method of Claim 23 further comprising comparing the local movement plans for planning areas having common boundary elements;

25. The method of Claim 24 further comprising resolving any conflicts in the common boundary elements by revising the local movement plans and, in the event of an unresolvable conflict, providing the unresolvable conflict to the human dispatcher.

26. A computer program product for use with a railway computer assisted train movement planner, wherein the railway network is divided into a plurality of planning areas; each planning area having at least one boundary element of common

track resources shared by an adjacent planning area, said computer program product comprising:

a computer usable medium having computer readable program code modules embodied in said medium for planning the movement of trains between adjacent planning areas; said computer readable program code modules comprising:

computer readable first program code module for causing a computer to generate a local movement plan for a planning area specifying the movement of trains into and out of the boundary elements associated with the planning area;

computer readable second program code module for causing a computer to evaluate the local movement plans for adjacent planning areas to detect conflicts at the respective boundary elements;

computer readable third program code module for causing a computer to identify resolutions for the detected conflicts; and

computer readable fourth program code module for causing a computer to modify the respective local movement plans in accordance with the identified resolutions.

27. A computer program product for use with a railway computer assisted train movement planner, wherein the railway network is divided into a plurality of planning areas; each planning area having at least one boundary element of common track resources shared by an adjacent planning areas, said computer program product comprising:

a computer usable medium having computer readable program code modules embodied in said medium for resolving conflicts in the use of a boundary element; said computer readable program code modules comprising:

computer readable first program code module for causing a computer to generate a database of planned usage of the boundary element;

computer readable second program code module for causing a computer to identify scheduling conflicts in the database;

computer readable third program code module for causing a computer to identify the trains involved in the conflict of the planned usage of the boundary element; and

computer readable fourth program code module for causing a computer to plan a delay in the movement of at least one of the identified trains to resolve the identified conflict.

28. A method of controlling the movement of plural trains along a network of track, where the network of track is divided into a plurality of planning areas, with a boundary element at a common track resource shared by adjacent planning areas, comprising:

(a) generating a local movement plan for each planning area independently of the movement plan for an adjacent planning area to control the movement of trains into and out of the boundary element associated with the adjacent planning area;.

(b) evaluating the generated local movement plans to identify a conflict at the respective boundary element;



(c) determining the sequence of movement of trains through the boundary elements to resolve the identified conflict; and

(d) modifying the generated local movement plans in accordance with the determined sequence of train movements.

29. A method of planning the movement of plural trains in two adjacent planning areas, where the adjacent planning areas contain at least one boundary element having common track resource such that only one of the plural trains may use the boundary element at a time, comprising:

(a) determining the sequence of movement of the plural trains through the boundary element; and

(b) generating a local movement plan for each of said adjacent planning areas as a function of the determined sequence of movement of trains through the boundary element.

30. The method of Claim 29 wherein said generating a local movement plan for one of the planning areas is independent of the generation of the local movement plan for the adjacent planning area.

31. A computer program product for use with a railway computer assisted train movement planner, wherein the railway network is divided into a plurality of planning areas; each planning area having at least one boundary element of common track resources shared by an adjacent planning area, said computer program product comprising:

a computer usable medium having computer readable program code modules embodied in said medium for resolving conflicts in the use of a boundary element; said computer readable program code modules comprising:

computer readable first program code module for causing a computer to determine the sequence of movement of the plural trains through the boundary element; and

computer readable second program code module for causing a computer to generate a local movement plan for the adjacent planning areas as a function of the determined sequence of movement of trains through the boundary element.